



Terrestrial Gastropoda from the caves of Presidente Olegário, southeastern Brazil

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Abstract: Samples of terrestrial gastropods were collected year-round in seven caves in Presidente Olegário municipality, Minas Gerais state, southeastern Brazil, during several expeditions from 2012 to 2014. Twenty-four taxa (plus a single freshwater species), mainly stylommatophorans, were found in the material. The following species are reported for the first time for Minas Gerais state: *Alcudia iheringi* Wagner, 1910 and *Helicina sordida* King, 1831 (Helicinidae); *Cecilioides consobrina* (d'Orbigny, 1841) (Ferussaciidae); *Entodina gionensis* Morretes, 1940 and *Scolodonta interrupta* (Suter, 1900) (Scolodontidae); *Megalobulimus sanctipauli* (Ihering & Pilsbry, 1900) (Strophocheilidae); *Drymaeus coarctatus* (Pfeiffer, 1845) (Bulimulidae); *Habroconus semenlini* (Moricand, 1846) (Euconulidae); and *Solaropsis* aff. *rosaria* (Pfeiffer, 1849) (Solaropsidae). Furthermore, the species *Drymaeus iracema* (Simone, 2015) and *Drymaeus terreus* (Simone, 2015) are synonymized with *Drymaeus coarctatus* (L. Pfeiffer, 1845).

Keywords: Minas Gerais; Neritimorpha; Stylommatophora; stygofauna; troglofauna..

Gastrópodes terrestres de cavernas da região de Presidente Olegário no sudeste brasileiro

Resumo: Amostras de gastrópodes terrestres foram coletadas em sete cavernas na região do município de Presidente Olegário, Minas Gerais, Brasil, durante múltiplas expedições ao longo dos anos de 2012 a 2014. Vinte-e-quatro táxons (mais uma única espécie dulciaquícola) foram encontrados, em sua maioria Stylommatophora. As seguintes espécies são aqui reportadas pela primeira vez para o estado de Minas Gerais: *Alcudia iheringi* Wagner, 1910 e *Helicina sordida* King, 1831 (Helicinidae); *Cecilioides consobrina* (d'Orbigny, 1841) (Ferussaciidae); *Entodina gionensis* Morretes, 1940 e *Scolodonta interrupta* (Suter, 1900) (Scolodontidae); *Megalobulimus sanctipauli* (Ihering & Pilsbry, 1900) (Strophocheilidae); *Drymaeus coarctatus* (Pfeiffer, 1845) (Bulimulidae); *Habroconus semenlini* (Moricand, 1846) (Euconulidae); e *Solaropsis* aff. *rosaria* (Pfeiffer, 1849) (Solaropsidae). Além disso, as espécies *Drymaeus iracema* (Simone, 2015) e *Drymaeus terreus* (Simone, 2015) são aqui sinonimizadas com *Drymaeus coarctatus* (L. Pfeiffer, 1845).

Palavras-chave: Minas Gerais; Neritimorpha; Stylommatophora; estigofauna; troglofauna.

Introduction

Brazilian cave-dwelling invertebrates have historically received scarce attention from researchers (Simone & Moracchioli 1994; Bichuette & Trajano 1999, 2003; Trajano & Bichuette 2010), a fact that is even more marked for mollusks (Salvador, 2019b). During the past decade, however, Dr. Maria E. Bichuette and her team from the Universidade Federal de São Carlos (UFSCar; São Carlos, Brazil) have been conducting collecting expeditions to cave systems throughout Brazil focusing on several animal taxa. The molluscan material they collected has been deposited in the malacological collection of the Museu de Zoologia da Universidade de São Paulo (MZSP; São Paulo, Brazil) and our team has been steadily studying it over the past years. Those efforts are leading to an increase in the amount of information on cave-dwelling mollusks (e.g.; Simone 2012, 2013; Salvador et al. 2016, 2017; Simone et al. 2020). This increase in studies is very welcome, both from the perspectives of mollusk taxonomy (Salvador 2019b) and of environmental protection, given that cave ecosystems are usually fragile but harbor a reasonable number of endemic species (Trajano 2000; Gallão & Bichuette 2012; Weigand 2013).

Some of those expeditions were undertaken by Dr. Bichuette to cave systems in the municipality of Presidente Olegário, Minas Gerais state, SE Brazil (September/2012 to June/2014). That karst region is famous for its multiple calcareous caves (Secutti & Buchuette 2013) and, amidst a wealth of specimens of varied taxa, Dr. Bichuette's team collected many terrestrial and a few freshwater snails. No surveys of the molluscan fauna have been published from that locality so far, so the material they collected brings new information. We study those specimens herein, reporting twenty-five species, some of which are new records for Minas Gerais state.

Material and Methods

All the material studied here was collected by Maria Elina Bichuette and her team (G.F. Damasceno, J.S. Gallo, L.P.A. Resende, I.A. Ribeiro, and T. Zepón) and is deposited in the MZSP. All the specimens were collected in calcareous caves in the municipality of Presidente Olegário, Minas Gerais state, SE Brazil (Figure 1).

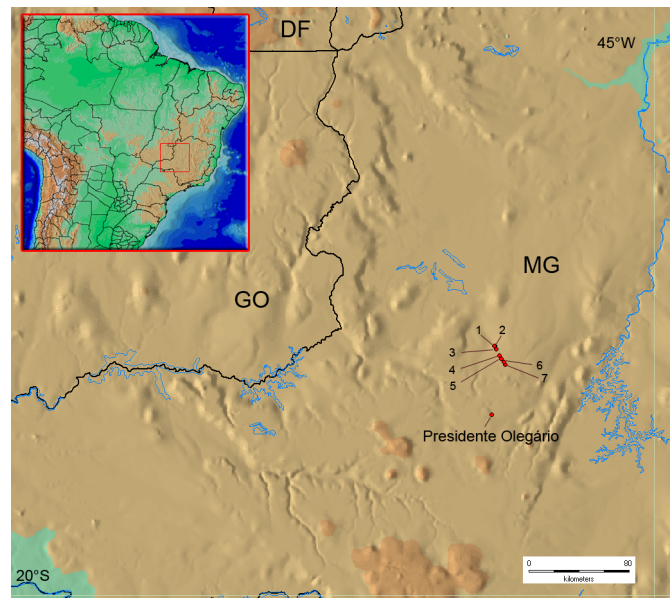


Figure 1. Map showing the municipality of Presidente Olegário in Minas Gerais state, SE Brazil, and the caves in the area: 1, Lapa Arco da Lapa; 2, Lapa da Fazenda São Bernardo; 3, Lapa da Juruva; 4, Lapa do Moacir; 5, Lapa Vereda da Palha; 6, Lapa Zé de Sidinei; 7, Toca do Charco. Abbreviations: DF, Distrito Federal; GO, Goiás state; MG, Minas Gerais state.

Presidente Olegário is located in the southern Alto São Francisco Basin, being inserted into the domains of the Cerrado Biome. The climate is tropical, semi-humid, with four to five months of drought (Nimer 1989). The karst of the region's landscape is rich with calcareous caves (Secutti & Buchuette 2013). Seven different caves were surveyed and collection took place in four instances, covering the whole seasonal range: September/2013, and January, April, and June/2014 (Table 1).

The material comprised both empty shells and a few animals collected live; the latter were preserved in ethanol 70%. For each collection effort, the time of active search used was always the same for each cave, according to the cave's size. Table 1 presents a list with all caves, alongside additional information on each.

Table 1. List of all caves in the municipality of Presidente Olegário, Minas Gerais state, Brazil, where the present material was collected.

Locality	Coordinates	Altitude	Cave length	Cave gap	Collection dates
Lapa Arco da Lapa	18°12'31"S 46°08'53"W	798 m	ca. 500 m	15 m	29/Sep/2013, 21/Jan/2014, 14/ Apr/2014, 13/Jun/2014
Lapa da Fazenda São Bernardo	18°16'37"S 46°06'46"W	802 m	ca 2000 m	10 m	30/Sep/2013, 23/Jan/2014, 13/ Apr/2014, 10/Jun/2014
Lapa da Juruva	18°19'19"S 46°04'53"W	808 m	ca. 1100 m	29 m	11/Jun/2014
Lapa do Moacir	18°11'10"S 46°09'34"W	773 m	ca. 200 m	5 m	20/Jan/2014, 17/Apr/2014, 13/ Jun/2014
Lapa Vereda da Palha	18°15'19"S 46°07'34"W	780 m	ca. 2500 m	25 m	27/Sep/2013, 22/Jan/2014, 15/ Apr/2014, 12/Jun/2014
Lapa Zé de Sidinei	18°18'06"S 46°05'41"W	850 m	ca. 650 m	20 m	28/Sep/2013, 24/Jan/2014, 16/ Apr/2014, 14/Jun/2014
Toca do Charco	18°11'06"S 46°09'39"W	764 m	ca. 80 m	3 m	29/Sep/2013, 20/Jan/2014, 17/ Apr/2014, 13/Jun/2014

Identification was conducted based on the original descriptions (and type material whenever possible), the catalog of Simone (2006), further taxonomic literature, and additional comparative material (preferably from Minas Gerais state when possible) housed in the collection of the MZSP. Selected specimens were analyzed under SEM in the Staatliches Museum für Naturkunde Stuttgart (SMNS, Stuttgart, Germany). Some specimens (either juvenile or fragmentary) could not be identified beyond genus or even family level (Table 1).

The following abbreviations are used herein. **Shell dimensions:** **H**, shell height (parallel to coiling axis); **D**, greatest shell width (perpendicular to H); **h**, aperture height (maximum length parallel to coiling axis); **d**, greatest width of aperture (maximum width perpendicular to coiling axis). Measurements were made with a digital caliper or, for minute shells, with the aid of computer software (Leica Application Suite [LAS] v.3.8.0 and ImageJ). **Material:** **sh**, empty shell(s); **spm**, specimen(s) collected live, ethanol-preserved. **Caves:** **AdL**, Lapa Arco da Lapa; **FSB**, Lapa da Fazenda São Bernardo; **Jur**, Lapa da Juruva; **Moa**, Lapa do Moacir; **TdC**, Toca do Charco; **VdP**, Lapa Vereda da Palha; **ZdS**, Lapa Zé de Sidinei. **Cave zones:** **EP**, epigean; **EZ**, entrance zone; **TZ**, twilight zone; **DZ**, dark (aphotic) zone.

Results

The complete list of species, the cave(s) (and the cave zone) where each occurs, and a relation of all the studied material are reported in Table 2. Species that require further discussion (*i.e.*, those with new records for Minas Gerais state) are addressed below and figured (Figure 2), arranged according to the classification of Bouchet et al. (2017). The other species (*i.e.*, not new records for Minas Gerais) are, nevertheless, recorded here for the first time from these caves.

Neritimorpha

Family Helicinidae

Genus *Alcadia* Gray, 1840

Alcadia iheringi Wagner, 1910

Figure 2A–C

Alcadia iheringi Wagner, 1910: 354, pl. 70, figs. 7–8; Morretes, 1949: 63; Salgado & Coelho, 2003: 151; Simone, 2006: 42, fig. 36; Agudo-Padrón, 2008: 151; Agudo-Padrón, 2012: 40; Agudo-Padrón, 2014: 10; Birckolz et al., 2016: table 1; Salvador et al., 2016: 61, figs. 2–4; Zepon & Bichuette, 2017: 5.

Alcadia (Alcadia) iheringi: Haas, 1959: 365.

Type locality. Nova Teutônia, Santa Catarina state, Brazil.

Previously known distribution. Type locality; caves in Alto Ribeira State Park, São Paulo state.

New records. Presidente Olegário: in caves “Lapa da Fazenda São Bernardo” and “Lapa Zé de Sidinei”. The present record extends the species range ca. 700 km to the northeast (ca. 650 km to the north).

Identification. Small conic-globose helicinid shell, with comparatively (among congeners) small and circular aperture.

Genus *Helicina* Lamarck, 1799

Helicina sordida King, 1832

Figure 2D–F

Helicina sordida King, 1832: 339; Pfeiffer, 1852: 622; Hupé, 1857: 62; Martens, 1867: 8; Salgado & Coelho, 2003: 152; Simone, 2006: 40, fig. 30.

Type locality. Rio de Janeiro, Brazil.

Previously known distribution. Rio de Janeiro (uncertain if state or city).

New records. Presidente Olegário: in cave “Lapa do Moacir”. The present record extends the species range at least 400 km to the northwest.

Identification. Wide helicinid shell with prominent keel on body whorl; aperture D-shaped, laterally elongated, with strongly thickened peristome.

Stylommatophora

Superfamily Achatinoidea

Family Ferussaciidae

Genus *Cecilioides* Férussac, 1814

Cecilioides consobrina (d’Orbigny, 1841)

Figure 2G

Achatina consobrina d’Orbigny 1837: 89, pl. 11 bis, figs. 10–12; d’Orbigny, 1841: 170.

Achatina pygmaea Pfeiffer, 1847: 148.

Cecilioides (Caecilianopsis) consobrina: Pilsbry, 1909–1910: 39, pl. 5, figs. 81–82; Hylton Scott 1948: 254; Schade, 1965: 2014; Fernandez & Castellanos, 1973: 271.

Cecilioides consobrina: Richards & Hummelinck, 1940: 8; Morretes, 1949: 131; Wurtz, 1950: 107; Parodiz 1957: 131; Altena, 1960: 50; Salgado & Coelho, 2003: 154; Simone, 2006: 183, fig. 666; Aguirre et al. 2007: 10, fig. 4.5; Miquel et al., 2007: 114; Oroño et al., 2007: 21; Miquel & Aguirre 2011: 109, fig. 8; Salvador et al., 2017: 139, figs. 13–14; Salvador et al., 2018: 114, fig. 9H-I.

Cecilioides (Karolus) consobrina: Figueiras, 1963: 87; Quintana, 1982: 80; Miquel & Herrera, 2014: 122.

Cecilioides consobrina consobrina: Ramírez et al, 2003: 276.

Type locality. Cuba, near Matanzas.

Previously known distribution. From Mexico (*C. consobrina veracruzensis* (Crosse & Fischer, 1877)) to Argentina (*e.g.*, Sandoval 1997; Miquel et al. 2007).

New records. Presidente Olegário: in cave “Lapa da Fazenda São Bernardo”. Despite this species being widely distributed, this is, up to our knowledge, the first specific record from Minas Gerais state.

Identification. Minute smooth glossy bullet-like shell, with long and narrow aperture.

Superfamily Scolodontoidea

Family Scolodontidae

Genus *Entodina* Ancey, 1887

Entodina gionensis Morretes, 1940

Figure 2H–J

Entodina gionensis Morretes, 1940: 257, pl. 1, figs. 1–4; Morretes, 1949: 138; Simone, 2006: 223, fig. 849; Agudo-Padrón, 2008: 164; Agudo-Padrón, 2014: 18; Birckolz et al., 2016: table 1; Salvador et al., 2016: 64, figs. 16–18.

Type locality. Vamiranga Shell Mound, Iguape municipality, São Paulo state, Brazil.

Table 2. List of all species found, with information on locality, cave zone inhabited by the species, whether it is a new occurrence for Minas Gerais state, and catalog number of the MZSP collection. Classification of the genus *Lilloiconcha* Weyrauch, 1965 in the newly-recognized family Cystopeltidae follows Salvador et al. (2020). Abbreviations: Caves: AdL, Lapa Arco da Lapa; FSB, Lapa da Fazenda São Bernardo; Jur, Lapa da Juruva; Moa, Lapa do Moacir; TdC, Toca do Charco; VdP, Lapa Vereda da Palha; ZdS, Lapa Zé de Sidinei. Cave zones: EP, epigeal; EZ, entrance zone; TZ, twilight zone; DZ, dark (aphotic) zone.

Species	Family	New record?	Cave	Cave zone	Collection Nr. (MZSP)
Neitimorpha					
<i>Alcudia iheringi</i> Wagner, 1910	Helicinidae	Yes	FSB, ZdS	EP, EZ, TZ, DZ	150032 (1 sh), 150047 (1 sh)
<i>Helicina brasiliensis</i> Gray, 1824	Helicinidae	No	FSB	EZ, TZ	137269 (5 sh), 137482 (2 sh)
<i>Helicina sordida</i> King, 1831	Helicinidae	Yes	Moa	TZ	150028 (1 sh)
<i>Helicina lundi</i> Beck in Pfeiffer, 1858	Helicinidae	No	AdL, Moa, TdC	EZ, TZ	137179 (1 sh), 137203 (1 sh), 137272 (1 spm), 150025 (2 sh)
<i>Helicina</i> sp.	Helicinidae	—	AdL, FSB, Jur, TdC, ZdS	EP, EZ, TZ, DZ	137142 (2 sh), 137149 (1 spm), 137185 (2 spm), 137186 (1 sh), 137273 (1 spm), 137564 (2 sh), 137566 (1 sh)
Caenogastropoda					
<i>Habeastrum strangei</i> Simone, Cavallari & Salvador, 2020	Diplommatinidae	No	FSB, Jur, Moa, VdP, ZdS	EP, EZ, TZ, DZ	137054 (5 spm), 137132 (2 spm), 137143 (3 sh), 137145 (5 spm), 137153 (1 spm), 137176 (1 sh), 137181 (6 spm), 137256 (6 sh), 137475 (4 sh), 147862 (2 spm), 147863 (1 spm)
Hygrophila					
<i>Biomphalaria</i> sp.	Planorbidae	—	Moa, TdC	TZ	137148 (3 sh), 137178 (1 sh)
Stylommatophora					
<i>Allopeas micra</i> (d'Orbigny, 1835)	Achatinidae	No	AdL, FSB, ZdS	EP, EZ, TZ, DZ	137264 (2 sh), 137265 (1 sh), 137268 (5 sh), 137276 (4 sh), 137284 (5 sh), 137424 (1 sh), 150017 (2 sh)
<i>Bulimulus</i> sp.	Bulimulidae	—	FSB	EZ	137479 (1 sh)
<i>Cecilioides consobrina</i> (d'Orbigny, 1841)	Ferussaciidae	Yes	FSB	EP	150049 (1 sh)
<i>Drymaeus coarctatus</i> (Pfeiffer, 1845)	Bulimulidae	Yes	FSB, Moa, VdP	EZ, TZ	137053 (1 sh), 137147 (1 sh), 137259 (2 sh), 137261 (1 sh), 137299 (1 spm), 137473 (2 sh), 150142 (1 sh), 150143 (1 sh)
<i>Dysopeas muibum</i> Marcus & Marcus, 1968	Achatinidae	No	AdL, FSB, Jur, VdP, ZdS	EP, EZ, TZ, DZ	137106 (1 sh), 137138 (1 sh), 137189 (10 sh), 137190 (1 sh), 137192 (2 sh), 137284 (5 sh), 137276 (4 sh), 137422 (1 sh), 137480 (2 sh), 137563 (1 sh)
<i>Entodina gionensis</i> Morretes, 1940	Scolodontidae	Yes	FSB	EZ, TZ	137269 (5 sh), 137474 (5 sh), 150048 (1 sh)
<i>Gastrocopta servilis</i> (Gould, 1843)	Gastrocoptidae	No	FSB	TZ	150046 (1 sh)
<i>Habroconus semenlini</i> (Moricand, 1846)	Euconulidae	Yes	AdL, FSB, Moa, VdP	EP, EZ, TZ, DZ	137182 (1 sh), 137270 (5 sh), 137428 (1 sh), 137429 (4 sh), 137472 (3 spm), 150024 (5 sh), 150042 (1 sh), 150053 (2 sh), 150137 (2 spm)
<i>Lamellaxis goodalli</i> (Miller, 1822)	Achatinidae	No	FSB	TZ, DZ	137431 (1 sh), 137478 (2 sh)
<i>Leiostracus</i> sp.	Bulimulidae	—	AdL	EZ	137204 (1 sh)

Continue...

Cavernicolous snails from Presidente Olegário

Continuation...

<i>Leptinaria lamellata</i> (Potiez & Michaud, 1838)	Achatinidae	No	FSB, TdC, ZdS	EP, EZ, TZ, DZ	137135 (1 sh), 137136 (1 sh), 137187 (1 sh), 137268 (5 sh), 137294 (1 sh), 137481 (2 sh), 150044 (1 sh)
<i>Lilloiconcha gordurasensis</i> (Thiele, 1927)	Cystopeltidae	No	FSB	EP	150040 (2 sh)
<i>Megalobulimus sanctipauli</i> (Ihering & Pilsbry, 1900)	Strophocheilidae	Yes	ZdS	EP(?)	unnumbered
Odontostomidae indet.	Odontostomidae	—	VdP	EZ, TZ	137101 (1 spm), 137102 (2 sh)
<i>Radiodiscus</i> sp.	Charopidae	—	FSB	TZ, DZ	137260 (2 sh), 137471 (10 spm)
<i>Scolodonta bounobaena</i> (d'Orbigny, 1835)	Scolodontidae	No	AdL, FSB, Jur, TdC, ZdS	EZ, TZ, DZ	137105 (1 sh), 137141 (2 sh), 137152 (1 sh), 137177 (1 sh), 137191 (4 sh), 137208 (3 spm), 137262 (5 sh), 137263 (1 sh), 137471 (10 spm), 137564 (2 sh), 137567 (1 sh)
<i>Scolodonta interrupta</i> (Suter, 1900)	Scolodontidae	Yes	FSB, Moa, VdP	EP, EZ, TZ, DZ	137146 (1 sh), 137174 (4 sh), 137258 (1 sh), 137267 (5 sh), 137271 (2 spm), 137293 (10 sh), 137300 (1 spm), 150025 (2 sh)
<i>Solaropsis</i> aff. <i>rosaria</i> (Pfeiffer, 1849)	Solaropsidae	Yes	Moa, TdC	EZ, TZ	137180 (1 sh), 150140 (1 sh), 150141 (1 sh)
Subulinidae indet.	Achatinidae	—	Moa, VdP, ZdS	EZ, TZ	137144 (2 sh), 137175 (1 sh), 137182 (1 sh)
Scolodontidae indet.	Scolodontidae	—	FSB, VdP, ZdS	EP, EZ, TZ, DZ	137104 (1 sh), 137266 (10 sh), 137298 (1 spm), 137471 (10 spm)
<i>Tamayoa banghaasi</i> (Thiele, 1927)	Scolodontidae	No	AdL, FSB, Moa, TdC, VdP, ZdS	EP, EZ, TZ, DZ	137056 (2 sh), 137150 (1 spm), 137202 (2 sh), 137274 (1 spm), 137275 (1 spm), 137476 (1 sh), 137568 (3 spm), 150050 (1 sh)

Previously known distribution. Known only from type locality in São Paulo state (Simone 2006). Outside of São Paulo, it has been reported from various municipalities in Santa Catarina state (Agudo-Padrón 2008), but those remain unconfirmed (Salvador et al. 2016).

New records. Presidente Olegário: in cave “Lapa da Fazenda São Bernardo”. The present record extends the species distribution ca. 700 to the north.

Identification. Discoid shell with flattened spire, sculptured by strongly sinuous ribs; aperture with strong parietal-columellar barrier and a marked palatal tooth. The present specimens have a slightly less developed parietal-columellar fold than typical *E. gionensis*.

Genus *Scolodonta* Doering, 1875
Scolodonta interrupta (Suter, 1900)
 Figure 2K–L

Streptaxis interruptus Suter, 1900: 331, pl. 3, fig. 5.

Scolodonta interrupta: Pilsbry, 1900: 385, pl. 12, figs. 6–8; Gude, 1902: 240; Kobelt, 1906: 69, pl. 51, figs. 21–23; Morretes, 1949: 166; Quintana, 1982: 104; Salgado & Coelho, 2003: 170; Simone, 2006: 225, fig. 856; Salvador et al., 2016: 65, figs. 23–25; Zepon & Bichuette, 2017: 5; Salvador, 2021: 64, figs. 4–6.

Type locality. Brazil, São Paulo state, Perus.

Previously known distribution. Known only from type locality (Salvador 2021). The report of Simone (2006) from Pará state is erroneous.

New records. Presidente Olegário: in caves “Lapa da Fazenda São Bernardo”, “Lapa do Moacir” and “Lapa Vereda da Palha”. The present record extends the species distribution ca. 500 km to the north.

Identification. Unsculptured scolodontid shell with slightly raised spire and small circular aperture lacking apertural barriers.

Superfamily Rhytidoidea
Family Strophocheilidae

Genus *Megalobulimus* K. Miller, 1878
Megalobulimus sanctipauli (Ihering & Pilsbry, 1900)
 Figure 2M–N

Strophocheilus oblongus var. *sanctaepauli* Ihering & Pilsbry in Pilsbry, 1900: 390.

Strophocheilus (Borus) sanctaepauli: Pilsbry, 1901: 123, pl. 20, fig. 63.

Strophocheilus (Borus) sanctipauli: Pilsbry, 1902: v, xciv [emendation].

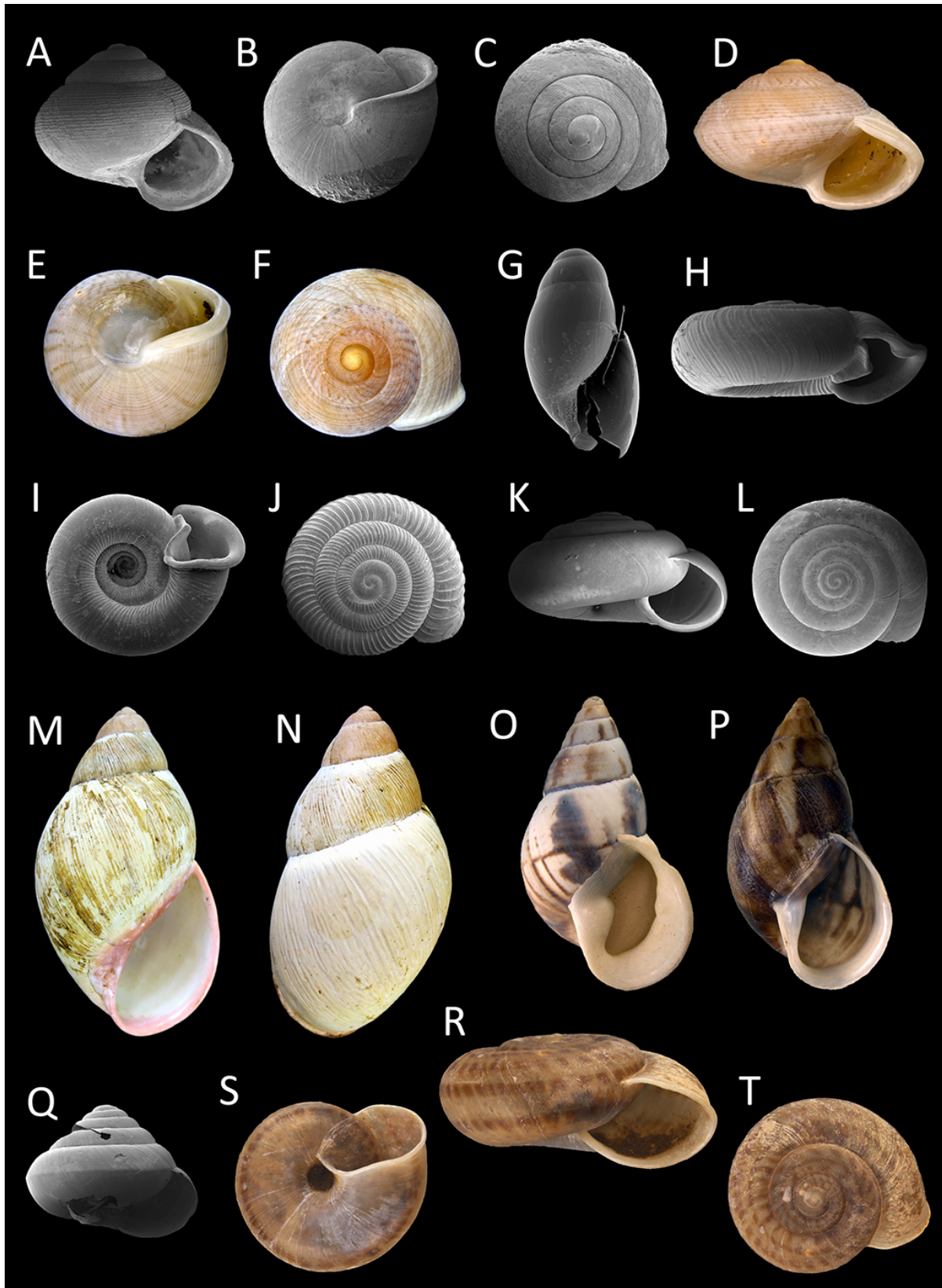


Figure 2. A–B. *Alcaldia iheringi* (MZSP 150047; H = 3.1 mm, D = 3.6 mm). C. *Alcaldia iheringi* (MZSP 150032; D = 3.5 mm). D–F. *Helicina sordida* (MZSP 150028; H = 5.3 mm, D = 7.8 mm). G. *Cecilioides consobrina* (MZSP 150049; H = 1.3 mm, D = 0.4 mm). H–I. *Entodina gionensis* (MZSP 150048; H = 1.6 mm, D = 4.0 mm). J. *Entodina gionensis* (MZSP 137471; D = 3.1 mm). K–L. *Scolodonta interrupta* (MZSP unnumbered; H = 4.1 mm, D = 7.0 mm). M–N. *Megalobulimus sanctipauli* (MZSP unnumbered; H = 11.5 mm, D = 6.5 mm). O. *Drymaeus coarctatus*, adult with thickened lip (MZSP 150142; H = 3.7 mm, D = 2.2 cm). P. *Drymaeus coarctatus*, young adult with barely reflected lip (MZSP 150143; H = 3.6 mm, D = 2.0 cm). Q. *Habroconus semenlini* (MZSP 150137; H = 3.7 mm, D = 4.7 mm). R–T. *Solaropsis* aff. *rosaria* (MZSP 150141; H = 10.0 mm, D = 19.4 mm).

Strophocheilus (Megalobulimus) sanctipauli: Bequaert, 1948: 137, pl. 13, fig. 7; Parodiz, 1957: 132; Fernández & Castellanos, 1973: 276; Quintana, 1982: 85.

Strophocheilus sanctipauli: Morretes, 1949: 141; Cuezco & Drahg, 1995: 197.

Strophocheilus santipauli: Fernandez, 1978: 149, fig. 1.

Melalobulimus (Megalobulimus) sanctipauli: Morretes, 1953: 68.

Megalobulimus sanctipauli: Abbott, 1989: 76, textfig.; Salgado & Coelho, 2003: 158; Simone, 2006: 219, fig. 831; Beltramino et al., 2012: 19, fig. 1; Beltramino, 2013: 469. Beltramino et al., 2015: 3, fig. 1; Zepon & Bichuette, 2017: 5.

Type locality. Brazil, São Paulo state, Botucatu municipality.

Previously known distribution. Brazil (São Paulo and Paraná states), Paraguay (Canindeyú and Alto Paraná departments), Argentina (Misiones and Corrientes provinces) (Beltramino 2013). Unpublished data also record the species in the two southernmost states of Brazil: Santa Catarina and Rio Grande do Sul (J.H. Fontenelle pers. comm. 2016).

New records. Presidente Olegário: in cave “Lapa Zé de Sidinei”. The present record extends the species range ca. 550 km to the northeast (ca. 500 km to the north).

Identification. Relatively tall and non-bulbous spire in comparison with congeners, with suture running almost perpendicular to shell axis.

Superfamily Orthalicoidea

Family Bulimulidae

Genus *Drymaeus* Albers, 1850

Drymaeus coarctatus (L. Pfeiffer, 1845)

Figure 2O–P

Bulimus coarctatus Pfeiffer, 1845: 73; Pfeiffer, 1848: 90; Pfeiffer, 1854: 80, pl. 22, figs. 22–23; Hupé, 1857: 56, pl. 10, fig. 4; Pfeiffer, 1858: 166.

Drymaeus coarctatus: Pilsbry, 1898: 195, pl. 28, figs. 17–20; Morretes, 1943: 117; Breure, 1979: 108; Salgado & Coelho 2003: 161; Simone, 2006: 136, fig. 445; Zepon & Bichuette, 2017: 5.

Drymaeus (Mormus) coarctatus: Morretes, 1949: 150.

Drymaeus (Drymaeus) coarctatus: Breure & Eskens, 1981: 16, pl. 5, fig. 5; Breure & Ablett, 2014: 5; 46, fig. 37F–H.

Kora terrea Simone, 2015: 51, figs. 1–5.

Kora iracema Simone, 2015: 54, figs. 15–20.

Drymaeus iracema: Salvador & Simone, 2016: 3; Birckoloz et al., 2016: 136, fig. 14.

Drymaeus terreus: Salvador & Simone, 2016: 3; Birckoloz et al., 2016: 138, fig. 15.

Type locality. Brazil (Pilsbry, 1898).

Previously known distribution. Reported only from the municipality of Lussanvira, Pereira Barreto, São Paulo state (Morretes 1943, 1949; Simone 2006).

New records. Presidente Olegário: in caves “Lapa da Fazenda São Bernardo”, “Lapa do Moacir”, “Lapa Vereda da Palha”, as well as in Povoado de Galena, 18°25’S 46°25’W (type locality of *Kora terrea*). It was also recorded in the Gruta do Morro dos Tapuias, 12°30’S 45°03’W, municipality of São Desidério, Bahia state (type locality of *K. iracema*). The present record extends the species range ca. 1,000 km to the northeast (ca. 750 km to the north).

Identification. Bulimoid shell; reticulate protoconch; aperture with reflected and strongly thickened peristome, unique among the congeners in Brazil. The peristome thickens with age, as younger specimens have a “typical” *Drymaeus*-like appearance (Figure 2P).

Remarks. *Drymaeus iracema* (Simone, 2015) and *D. terreus* (Simone, 2015) were originally described as troglobiont species classified in the genus *Kora* Simone, 2012. The former is known from São Desidério municipality in Bahia state and the latter, from Presidente Olegário municipality, in Minas Gerais state. Salvador & Simone (2016) argued that they belonged in *Drymaeus* Albers, 1850 based on the reticulate protoconch sculpture. Further conchological features such as the strongly expanded peristome, the straight profile of the spire, and the upright columellar region, allow us to propose here that both *D. iracema* (holotype MZSP 104964) and *D. terreus* (holotype MZSP 106215), conchologically indistinguishable from one another, are junior synonyms of *Drymaeus coarctatus* (lectotype NHMUK 1975560; Simone 2006: fig. 445; Breure & Ablett 2014: fig. 37F–H).

Drymaeus coarctatus is thus widely distributed in eastern Brazil: from western Bahia state (São Desidério municipality), through Minas Gerais state (Presidente Olegário municipality, and newly reported specimens MZSP 152050, 152078, and 152091 from the municipalities of Paracatu and Unai) and Espírito Santo state (newly reported specimen, USNM IZ530536, from the collection of the Smithsonian National Museum of Natural History, Washington, D.C., USA), to northern São Paulo state (Simone 2006: Lussanvira, an old railway station in Pereira Barreto municipality).

The shell of this species can present tooth-like thickenings on the palatal and basal regions of the peristome, as well as a more marked fold on the apical end of the columellar region (e.g., lectotype and specimen USNM IZ530536). All these structures supposedly develop as the individual grows older and deposits more shell material on the peristome. The shell can have a flame-like coloration pattern of the periostracum (MZSP 106215) or a pattern composed of several brown narrow spiral stripes (USNM IZ530536). Such intraspecific variation in shell color is well documented in other species of *Drymaeus* (e.g., Salvador et al. 2018).

Superfamily Trochomorpoidea

Family Euconulidae

Genus *Habroconus* Crosse & P. Fischer, 1872

Habroconus semenlini (Moricand, 1846)

Figure 2Q

Helix Semenlini Moricand, 1846: 149, pl. 5, fig. 17; Pfeiffer, 1846: 457, 1848: 31, 1853: 32; Reeve, 1854: pl. 112, fig. 637; Hupé, 1857: 14.

Helix (Hyalina) semenlini: Albers, 1860: 73.

Hyalina semenlini: Heynemann, 1868: 106; Clessin, 1888: 166.

Hyalina (Conulus) semenlini: Martens, 1868: 175.

Conulus semenlini: Ihering, 1894: 38.

Guppya semenlini: Ancey, 1897: 9.

Guppya semenlini: Pilsbry, 1900: 386.

Vitrea semenlini: Suter, 1900: 331.

Habroconus (Pseudoguppya) semenlini: Haas, 1953: 205, 1959: 365.

Habroconus (Pseudoguppya) semenlini: Baker, 1928: 12; Morretes, 1949: 137; Figueiras, 1963: 87; Schade, 1965: 214; Fernandez & Castellanos, 1973: 274; Quintana, 1982: 79.

Habroconus semenlini: Klappenbach, 1967: 42; Agudo-Padrón, 2008: 166; Santos et al., 2010: 516; Agudo-Padrón, 2014: 18.

Habroconus semenline: Salgado & Coelho, 2003: 154.

Pseudoguppya semenlini: Salvador et al., 2016: 65; Salvador et al., 2018: 124, figs. 14A–C; Zepon & Bichuette, 2017: 5; Salvador, 2019a: 95; Silva et al., 2019: 184, fig. 4A–C.

Type locality. Bahia state, Brazil.

Previously known distribution. Brazil (Alagoas, Bahia, Rio de Janeiro, São Paulo, Paraná, Santa Catarina, and Rio Grande do Sul states), Paraguay, Uruguay, Argentina (Silva et al. 2019).

New records. Presidente Olegário: in caves “Lapa Arco da Lapa” and “Lapa da Fazenda São Bernardo”, “Lapa do Moacir” and “Lapa Vereda da Palha”. The present record fills a gap in the species’ distribution.

Identification. Typical euconulid shell; body whorl with marked angulation and relatively tall compared to congeners; broad D-shaped aperture.

Superfamily Sagdoidea

Family Solaropsidae

Genus *Solaropsis* Beck, 1837

Solaropsis aff. *rosaria* (L. Pfeiffer, 1849)

Figure 2R–T

Solaropsis rosarium [sic]: Salvador et al., 2015: 68, figs. 7–9.

Type locality. Banks of the Amazon River (Pfeiffer, 1853; Pilsbry, 1933).

Previously known distribution. From Amazonas to Mato Grosso do Sul, Brazil (Salvador et al., 2015). Previous reports from Suriname and “New Granada” have been considered spurious (Pilsbry, 1933).

New records. Presidente Olegário: in caves “Lapa do Moacir” and “Toca do Charco”. The present record, if confirmed, would mean an increase of ca. 300 km in the species’ distribution towards the southeast.

Identification. The present specimens do not exactly match the species *S. rosaria*, typically known from the Amazon biome in South America. However, they are indistinguishable from the specimens from Tocantins state, in central Brazil, that Salvador et al. (2015) called *S. rosarium* [sic]. The present specimens thus belong to the same species as those of Salvador et al. (2015), but their identity remains elusive for now.

The specimens are also reminiscent of *S. derbyi* Ihering, 1900 from São Paulo state, southeastern Brazil. However, that species is poorly defined and its type specimen is badly preserved (Simone 2006: fig. 937).

The taxonomy of *Solaropsis* in Brazil is riddled with poorly-defined species, a few potentially invalid names, several potential synonyms, unrecognized intraspecific variability of shell morphology, and almost no knowledge of anatomical features, DNA, and basic biology (Cuezzo 2002; Calcutt et al. 2020). As such, proper identification of the present specimens will have to wait until a better definition of species boundaries in the genus is in place.

Remarks. This species has been lately classified in the genus *Psadara* Miller, 1878 (e.g., Simone 2006); however, a recent molecular analysis has confirmed that *Psadara* is a synonym of *Solaropsis* (Calcutt et al. 2020).

Discussion

Orthalicoidea is usually the most diverse group of land snails in any sample of mollusks taken in Brazil (Salvador 2019b). However, as already pointed out by Salvador et al. (2016), this does not seem to hold for the troglofauna, in which Subulininae and Scolodontidae are represented by a more diverse assembly of species among the stylommatophorans. In the present material, only four orthalicoid species were found (and only in the epigeal and the entrance zone of the caves; Table 2). Meanwhile, several subulinine and scolodontid taxa were recovered from the epigeal to the dark aphotic zone of the caves (Table 2). From all species reported herein, only *Habeastrum strangei* is a known cave endemic (Simone et al., 2020); all the others have wider distributions in non-cave environments.

Moreover, a curiously high number (four) of heliciniid species was found in the material, including living specimens in the aphotic zones of the caves (Table 2). Our previous studies on cavern snails have always been poor on heliciniid specimens (e.g., Salvador et al. 2016, 2017). Neotropical heliciniids are typically considered arboreal species in the literature (e.g., Richling 2004), but here it can be seen that they might inhabit other habitats as well.

From the caves studied here, almost all of them have little left of the original Cerrado vegetation in their surroundings; the place was cleared to give way to pasture or agriculture and only a couple of meters of native vegetation remains in the entrance area of each cave (T. Zepon, personal communication 2016). Only a single cave (“Lapa Arco da Lapa”) has a larger surrounding area of native vegetation (ca. 100 m) (T. Zepon, personal communication 2016). That does not seem to affect the species composition of that cave, as almost all the species found in Lapa Arco da Lapa were also recorded from other caves; the single exception is *Leiostracus* sp., an arboreal snail found in the epigeal area there (Table 2).

Several of the species reported here are first records for Minas Gerais state (Results section; Table 2). This report extends the geographical distribution of some species, while simply filling “distribution gaps” of others. Moreover, the present records are especially important, as they are among the few dealing with molluscan troglofauna in the region and Brazil as a whole. Land snails are considered the most threatened group of animals (Lydeard et al. 2004; Régnier et al. 2008) and many of them inhabit, and could likely be endemic to, caves (Simone & Moracchioli 1994; Simone 2013; Weigand 2013; Salvador 2019b).

The vast majority of caves in Brazil completely lack legal protection. Better known geographical distributions improve arguments for conservation, as the Brazilian legislation states that a cave must be protected if it harbors rare or endemic species (Campos-Filho et al. 2014). Hence the great importance of troglofaunal inventories, as delays in ensuring proper protection to those habitats might result in irreparable biodiversity loss.

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Author Contributions

Rodrigo B. Salvador: conceptualized the study; led the taxonomic study and writing of the manuscript.

Fernanda S. Silva: led the taxonomic study and writing of the manuscript.

Daniel C. Cavallari: contributed to the study and manuscript writing.

Luiz Ricardo L. Simone: contributed to the study and manuscript writing.

Conflicts of Interest

The authors declare that they have no conflict of interest related to the publication of this manuscript.

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